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FOSSIL AND EXTANT MACROCHELID MITES (ACARI: MACROCHELIDAE) PHORETIC ON DROSOPHILID FLIES (DIPTERA: DROSOPHILIDAE)

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Abstract.—A drosophilid specimen in Dominican amber, *Protochymomyza miocena* Grimaldi, has phoretic macrochelid mites attached to it. This find is compared with extant phoretic associations between macrochelid mites and adult drosophilids.

It is well documented that many Mesostigmata, Prostigmata and Astigmata Acari (mites) are phoretic on a wide variety of insects from various orders, but information on the ages of such behavior, as indicated in the fossil record, is very sparse. During routine examination of amber for examples of symbiosis in the fossil record, we have found several examples of mite phoresy on insects in samples of amber from the Dominican Republic. Due to the rapid and very complete method of preservation provided by amberization examples of behavior in the fossil record can be excellently preserved.

MATERIALS AND METHODS

An amber piece containing three mites attached to a drosophilid fly was recognized by the senior author during an examination of samples of Dominican Republic amber (Fig. 1). These deposits have been estimated to range from Lower Miocene to Upper Eocene in age (25–40 million years) and represent the oldest known fossil invertebrates from the West Indies and probably all Mesoamerica. The adult fossil drosophilid fly, *Protochymomyza miocena,* was described by Grimaldi (1987). The fossil and extant mites were identified as belonging to the Macrochelidae by G. W. Krantz. For his assistance we are very appreciative.

Extant cases of phoretic mites on adult Drosophilidae were found by the junior author on material swept in the field. Specimens were critical point dried from absolute ethanol, sputter-coated with 200Å gold and examined with a scanning electron microscope under a 10 KV beam current.

RESULTS AND DISCUSSION

Extant collections of adult Drosophilidae revealed individuals with several types of phoretic mites, including macrochelids. Figures 2 and 3 illustrate how macrochelid mites position themselves on the flies. Figure 2 shows a male *Neotanygastrella* sp. collected from Arima, Trinidad, with two macrochelid mites on the ventral surface of the abdomen. Another macrochelid mite, lodged in the cervical membrane between

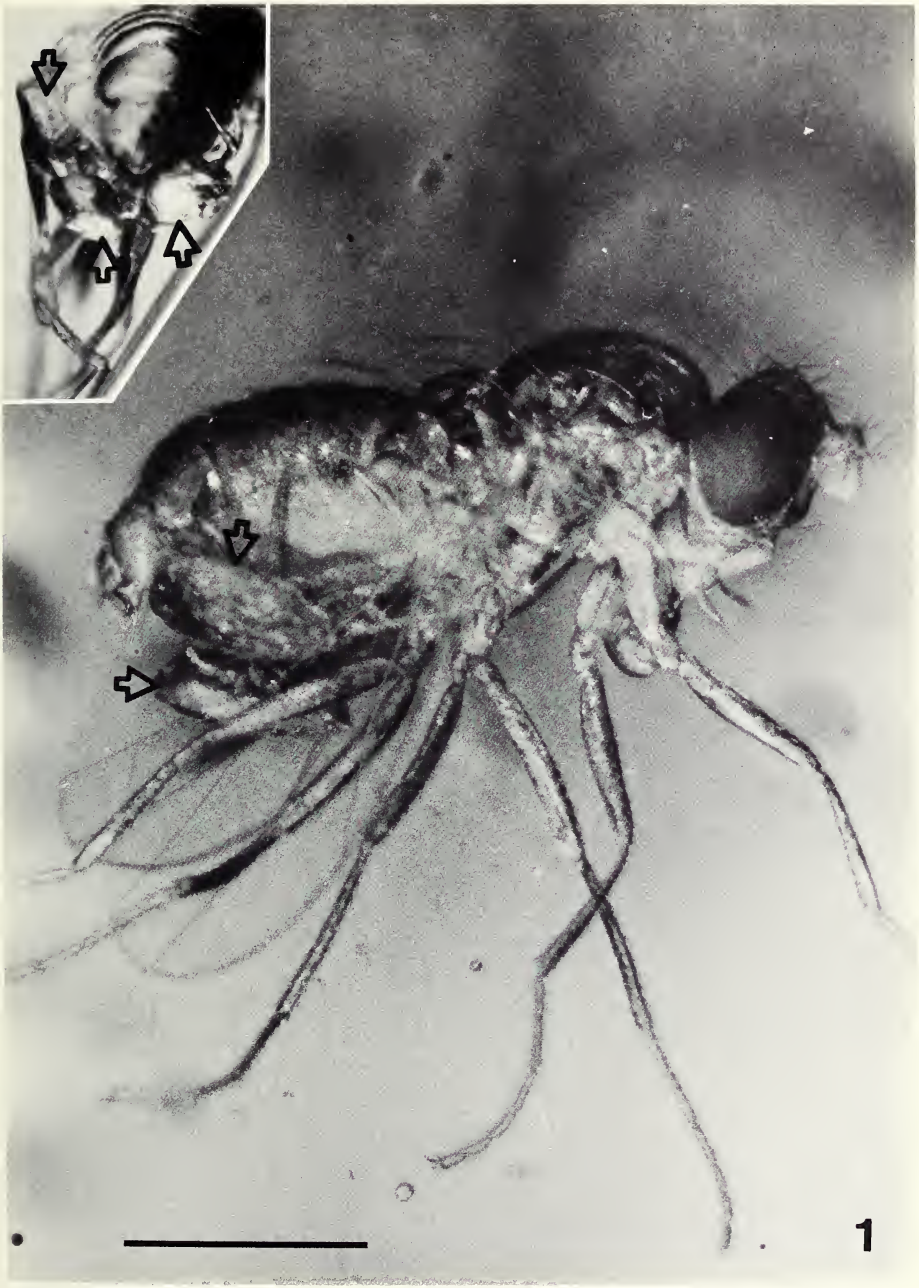
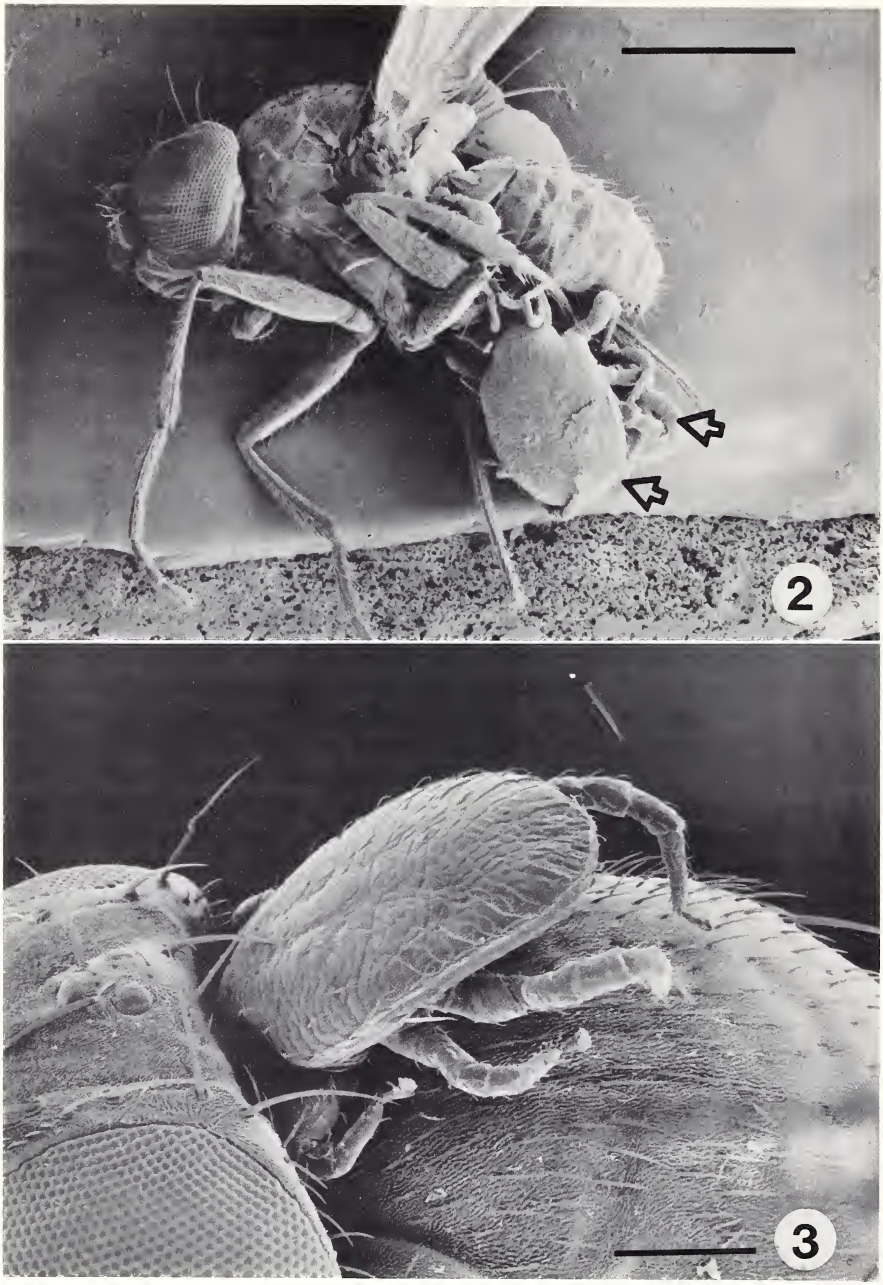


Fig. 1. Fossil male drosophilid (*Protochymomyza miocena* Grimaldi) in Dominican amber, showing two (arrows) of the three macrochelid mites attached to the ventral and latero-ventral portions of the abdomen (scale bar = 0.5 mm). Insert shows terminal view of the fossil, revealing all three mites (arrows).



Figs. 2, 3. Macrochelids on extant drosophilids. 2. *Neotanygastrella* sp. from Arima, Trinidad, with two mites attached to the abdomen (arrows) (scale bar = 0.5 mm). 3. *Drosophila* sp. from Trinidad with a mite lodged in the cervical membrane (scale bar = 200 μm).

the head and thorax (dorsal) of *Drosophila* sp. collected in Trinidad, is shown in Figure 3.

The fossil male *Protochymomyza miocena* has three macrochelid mites attached to the ventral and latero-ventral surface of the abdomen.

Macrochelid mite phoresy on members of adult Drosophilidae would be restricted to habitats supporting the developmental stages of both fly and mite. Extant *Neotanygastrella* and their close relatives in the genus *Chymomyza* breed in decaying bark (e.g., Grimaldi, 1986), a natural environment also for macrochelid mites. It is likely that the fossil species (being closely related to extant *Chymomyza* species) also bred in decaying bark. These flies normally feed on fungal (basidiomycetes) infested wood.

It is interesting that in extinct and extant situations, the mites are attached to the ventral or ventral-lateral surface of the abdomen. In the case of extant relationships of macrochelid mites on drosophilids, there has never been found more than 3 mites per fly (as is found in the fossil) and they are always in a position that does not unbalance the fly during flight. Normally, if 3 mites are on one fly, two would always be attached just lateral to the median line on the same but opposite parts of the fly's body. The third would usually be located on the ventral median line either between the other two mites or slightly anterior or posterior to them. This is the position of three mites on the fossil drosophilid.

The primary benefit of any type of phoresy is dispersal (Binns, 1982). Specifically, by these mites being dispersed by drosophilids, they are tracking a potential food since macrochelids are known to feed on fly eggs (Farish and Axtell, 1971). Drosophilids can benefit since macrochelid mites may attack natural fly parasites. Macrochelids are well known for feeding on nematodes in culture (Kinn and Witcosky, 1977), and drosophilids are parasitized by allantonematid nematodes (Welch, 1959), and in some cases this can be a major factor in mortality (Montague and Jaenike, 1985). Thus it is interesting that another fossil drosophilid, *Chymomyza primaeva* (Grimaldi, 1987), recovered from the same deposits as *P. miocena,* was parasitized by allantonematid nematodes (Poinar, 1984). Thus, by feeding on the free-living infective stages of allantonematid nematodes, macrochelid mites could lower the rate of drosophilid infection. Presumably, the relationships between macrochelids, drosophilids, and allantonematids was established some 25–40 million years before present.

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